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IMPACT OF DOOR-TO-BALLOON TIME ON CLINICAL OUTCOME OF PRIMARY PERCUTANEOUS CORONARY INTERVENTION AMONG THE PATIENTS OF STEMI AT A LARGE TERTIARY CARE HOSPITAL

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Abstract

Objective: *There is inadequate information to conclude that patients with ST-elevation myocardial infarction (STEMI) death at a significantly higher rate when there is a slight incremental increase in door-to-balloon (D2B) time.*

Methods: *The cross sectional study design was used to collect data, total 577 patients were enrolled and research was carried out in the department of Cardiology, Punjab Institute of Cardiology, Lahore for a duration of six months. Current study outcome was in-hospital mortality and complications. The principal independent variable was door-to-balloon time, which is the time from hospital arrival to balloon inflation*

Results: *The mean age of the cases in this study in Group A is 52.29 ± 11.11 and 51.65 ± 13.09 in Group B. There were 344 (88.9%) male and 43 (11.1%) females in Group A similarly, 164 (86.3%) male and 26 (13.7%). There were 128 (33.1%) diabetics, 184 (47.5%) hypertensive, 7 (1.8%) hyperlipidemia patients, 202 (52.2%) smokers and 141 (36.4%) patients with family history of premature coronary artery disease found in Group A, similarly, 65 (34.2%) diabetic, 88 (46.3%) hypertensive, 9 (4.7%) hyperlipidemia patients, 92 (48.4%) smokers and 75 (39.5%) patients with family history of premature coronary artery disease found in Group B. 1 (0.3%) in Group A and 1 (0.5%) in Group B use illicit drug in this study. In Group A 12 (3.1%) patients found with prior PCI, 0 (0%) with prior CABG, and 14 (3.6%) with prior MI, similarly in Group B 16 (8.4%) patients found with prior PCI, 1 (0.5%) with prior CABG and 7 (3.7%) with prior MI in this study. The comparison of outcomes i.e., MI, cardiogenic shock, heart failure, CVA/Stroke, hemorrhagic, dissection, death, stent thrombosis, bleeding events within 72 hours, temponade, new requirement for dialysis, heamotoma, no flow reflow, perforation, and other vascular complications showed that there is no significant difference between both groups as p-values found insignificant i.e., 0.321, 0.350, 0.073, 0.537, 0.100, 0.483, 0.216, 0.321, 0.607, 1.00, 1.00, 0.668, 0.483, 1.00 and 0.483 respectively. (Table 2)*

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Conclusions: *Treatment for acute myocardial infarction requires a door-to-balloon time, while there has been a notable improvement in door-to-balloon timeframes for patients receiving primary percutaneous coronary intervention (PCI) for ST-segment elevation myocardial infarction, the rate of in-hospital mortality has remained essentially the same. These statistics indicate that further measures are required to decrease the number of deaths that occur within the hospital among this specific group of individuals.*

INTRODUCTION

Primary percutaneous coronary intervention (PCI) is currently the preferred treatment for acute ST-segment elevation myocardial infarction. Previous observational studies have shown a strong association between prompt performance of primary PCI, as assessed in terms of the door-to-balloon time (the interval from the patient's arrival at the hospital to inflation of the balloon to restore flow), and reduced mortality. [1-2] On the basis of these data, current joint clinical practice guidelines of the American College of Cardiology and the American Heart Association (ACC–AHA) endorse a door-to-balloon time of 90 minutes or less as the goal, giving it a Class I (highest level) recommendation. [3-5] Because of this recommendation, door-to-balloon time has become the focus of local, regional, and national quality-improvement initiatives and is currently tracked by a number of clinical registries. Consequently, door-to-balloon times are now publicly reported, and the percentage of patients for whom the door-to-balloon time is 90 minutes or less has evolved into a key quality metric. Institutional door-to-balloon times also have financial implications, since they are now tied to reimbursement from the Centers for Medicare and Medicaid Services (CMS).[6]

Although these efforts have been remarkably successful in reducing national door-to-balloon times, it is not known whether these improvements are associated with an overall reduction in mortality.[7-9] A recent study from a large regional cardiovascular collaborative did not show that annual mortality decreased among patients undergoing primary PCI, despite large reductions in door-to-balloon times.[10-11]

Rapid revascularization in ST-elevation myocardial infarction (STEMI) was shown in numerous studies to reduce in-hospital and long-term mortality, as well as to reduce non-fatal complications. [12-14] The preferred mode of revascularization is primary percutaneous coronary intervention (PPCI) and the gold standard time from hospital entry to PPCI (door-to-balloon time, D2B) was set at There is general consensus that shorter FMC and D2B yield better prognosis. [15] However, in their publication in 2013, Menees et al.[16] showed unchanged in-hospital mortality for patients who underwent PPCI for STEMI, despite significant improvement in US national D2B time. Lack of reduced mortality at a population level may hamper the rationale for the robustness of current treatment for STEMI.[17-18] We previously reported significantly decreased D2B time after an intervention, from a median value of 67 min to 47 min (0.0001).[19]

However, that study was limited to regional results and may have lacked sufficient power to detect a survival benefit related to the improved treatment times. Therefore, we used local data to evaluate annual trends in door-to-balloon times to assess whether shorter times are associated with a change in in-hospital mortality among patients undergoing primary PCI for ST-segment elevation myocardial infarction

Methodology

The cross sectional study design was used to collect data, total 577 patients were enrolled and research was carried out in the department of Cardiology, Punjab Institute of Cardiology, Lahore for a duration of six months. Current study outcome was in-hospital mortality and complications during hospital stay. The principal independent variable was door-to-balloon time, which is the time from hospital arrival to balloon inflation. Patients were stratified based on their

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time from symptom onset-to-door time (<90 minutes and > 90 minutes) and whether they had ACC/AHA high-risk factors (anterior/ septal location, diabetes mellitus, heart rate > 100 beats/min, systolic blood pressure 100 mm Hg) (11). Other patient-level variables included age 20-95 years, gender, demographic statistics and clinical characteristics. Clinical characteristics consisted of medical history (diabetes, hypertension, dislipidemia, smoker, family history of premature coronary disease, Illicit Drug Use, Prior PCI , Prior CABG and prior MI). presentation characteristics (time from symptom onset-to-presentation, whether a prehospital ECG was performed, the admission time of day [day, evening, or night], admission day of week [weekday or weekend], chest pain at presentation, systolic blood pressure, heart rate, heart failure); and the results of the diagnostic ECG (number of leads with ST-segment elevation, AMI location, ST-segment depression, nonspecific ST/T-wave changes, Q-wave). We first examined the association between patient characteristics and in-hospital mortality, using chi-square tests to assess for the association between categorical variables and in-hospital mortality and t tests or F tests to assess for the association between continuous variables and in-hospital mortality. The stratified by symptom onset-to-door time (<90 minutes and > 90 minutes) and presence or absence of anterior/septal location, diabetes mellitus, heart rate 100 beats/min, systolic blood pressure 100 mm Hg, and any of these baseline risk factors. Random effects were specified for the main intercept and the coefficients of calendar time in the model. We replicated the model in all the strata of symptom onset-to-door time and baseline risk factors, as defined above; the stratification variable was not included in the corresponding subgroup model. We also estimated a final set of models using the whole cohort, each of which included the interaction between door-to-balloon time and one of these stratification variables. We performed secondary analyses that included the 2.0% of patients transferred out and assumed they survived to discharge. To evaluate the potential effect of decreasing length of stay on our results, we also performed secondary analyses that evaluated mortality within 72 h. The results of both of these secondary analyses were not substantially different from the original. Statistical analyses were performed using SPSS version 25. The investigators had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Continuous data are presented as means ± standard deviations, and categorical variables as numbers and percentages. Associations of D2B time with categorical demographic variables and mortality within 30 days after discharge were examined according to D2B below and above the median value for the entire cohort. The v2 test was used to analyze categorical values between groups, and the T-test for continuous variables. To assess the association between mortality within 30 days after discharge and post-percutaneous coronary intervention (PCI) ejection fraction, we considered ejection fraction as a categorical variable with a threshold point (45%). Associations of clinical parameters with mortality within 30 days after discharge were evaluated. The results were considered statistically significant for two-sided P< 0.05. SPSS version 25.0 was used to perform all statistical analyses.

Results

The mean age of the cases in this study in Group A is 52.29 ± 11.11 and 51.65 ± 13.09 in Group B. There were 344 (88.9%) male and 43 (11.1%) females in Group A similarly, 164 (86.3%) male and 26 (13.7%). There were 128 (33.1%) diabetics, 184 (47.5%) hypertensive, 7 (1.8%) hyperlipidemia patients, 202 (52.2%) smokers and 141 (36.4%) patients with family history of premature coronary artery disease found in Group A, similarly, 65 (34.2%) diabetic, 88 (46.3%) hypertensive, 9 (4.7%) hyperlipidemia patients, 92 (48.4%) smokers and 75 (39.5%) patients with family history of premature coronary artery disease found in Group B. 1 (0.3%) in Group A and 1 (0.5%) in Group B use illicit drug in this study. In Group A 12 (3.1%) patients found with prior PCI, 0 (0%) with prior CABG, and 14 (3.6%) with prior MI, similarly in

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Group B 16 (8.4%) patients found with prior PCI, 1 (0.5%) with prior CABG and 7 (3.7%) with prior MI in this study. (Table 1)

The comparison of outcomes i.e., MI, cardiogenic shock, heart failure, CVA/Stroke, hemorrhagic, dissection, death, stent thrombosis, bleeding events within 72 hours, temponade, new requirement for dialysis, heamotoma, no flow reflow, perforation, and other vascular complications showed that there is no significant difference between both groups as p-values found insignificant i.e., 0.321, 0.350, 0.073, 0.537, 0.100, 0.483, 0.216, 0.321, 0.607, 1.00, 1.00, 0.668, 0.483, 1.00 and 0.483 respectively. (Table 2)

Table 1: Descriptive statistics of Demographics and Risk Factors

Descriptive statistics of Demographics and Risk Factors				
Variables	**Group A (< 90 minutes of Door to needle time) n=387**		**Group A (≥ 90 minutes of Door to needle time) n=190**	**P-Value**
Age	52.29 ± 11.11		51.65 ± 13.09	0.539
Gender	**Male**	344 (88.9%)	164 (86.3%)	0.371
	Female	43 (11.1%)	26 (13.7%)	
Diabetes	**Yes**	128 (33.1%)	65 (34.2%)	0.786
	No	259 (66.9%)	125 (65.8%)	
Hypertension	**Yes**	184 (47.5%)	88 (46.3%)	0.781
	No	203 (52.5%)	102 (53.7%)	
Dyslipidemia	**Yes**	7 (1.8%)	9 (4.7%)	0.044
	No	380 (98.2%)	181 (95.3%)	
Smokers	**Yes**	202 (52.2%)	92 (48.4%)	0.394
	No	185 (47.8%)	98 (51.6%)	
Family History of premature coronary disease	**Yes**	141 (36.4%)	75 (39.5%)	0.478
	No	246 (63.6%)	115 (60.5%)	
Illicit Drug Use	**Yes**	1 (0.3%)	1 (0.5%)	0.607
	No	386 (99.7%)	189 (99.5%)	
Prior PCI	**Yes**	12 (3.1%)	16 (8.4%)	0.005

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	No	375 (96.9%)	174 (91.6%)	
Prior CABG	Yes	0 (0%)	1 (0.5%)	0.153
	No	387 (100%)	189 (99.5%)	
Prior MI	Yes	14 (3.6%)	7 (3.7%)	0.978
	No	373 (96.4%)	183 (96.3)	

Table 2: Comparison of Clinical Outcomes Between Both Groups.

Comparison of outcomes between both groups				
Variables		Group A (< 90 minutes of Door to needle time) n=387	Group A (≥ 90 minutes of Door to needle time) n=190	P-Value
MI	Yes	2 (0.5%)	0 (0%)	0.321
	No	385 (99.5%)	190 (100%)	
Cardiogenic Shock	Yes	9 (2.3%)	7 (3.7%)	0.350
	No	378 (97.7%)	183 (96.3%)	
Heart Failure	Yes	3 (0.8%)	5 (2.6%)	0.073
	No	384 (99.2%)	185 (97.4%)	
CVA/Stroke	Yes	4 (1%)	1 (0.5%)	0.537
	No	383 (99%)	189 (99.5%)	
If yes/ Hemorrhagic	Yes	0 (0%)	0 (0%)	0.100
	No	387 (100%)	190 (100%)	
Dissection	Yes	1 (0.3%)	0 (0%)	0.483
	No	386 (99.7%)	190 (100%)	
Death	Yes	7 (1.8%)	1 (0.5%)	0.216
	No	380 (98.2%)	189 (99.5%)	
Stent thrombosis	Yes	2 (0.5%)	0 (0%)	0.321
	No	385 (99.5%)	190 (100%)	
Bleeding events within 72 hours	Yes	1 (0.3%)	1 (0.5%)	0.607
	No	386 (99.7%)	189 (99.5%)	
Temponade	Yes	0 (0%)	0 (0%)	1.00
	No	387 (100%)	190 (100%)	
New Requirement for dialysis	Yes	0 (0%)	0 (0%)	1.00
	No	387 (100%)	190 (100%)	
Heamotoma	Yes	8 (2.1%)	5 (2.6%)	0.668
	No	379 (97.9%)	185 (97.4%)	
No flow reflow	Yes	1 (0.3%)	0 (0%)	0.483
	No	386 (99.7%)	190 (100%)	

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Perforation	**Yes**	0 (0%)	0 (0%)	1.00
	No	387 (100%)	190 (100%)	
Other Vascular Complications	**Yes**	1 (0.3%)	0 (0%)	0.483
	No	386 (99.7%)	190 (100%)	

Discussion:

In this large observational study of patients with STEMI undergoing primary PCI, we found clear evidence of increased mortality with longer door-to-balloon times. This association was seen for patients regardless of symptom onset-to-door time and for patients with and without high-risk factors. These findings support the current guideline-based recommendations for rapid PCI and provide evidence that this recommendation is valid for all patients with STEMI and presentation within 6 h of the onset of symptoms.

The mean age of the cases in this study in Group A is 52.29 ± 11.11 and 51.65 ± 13.09 in Group B. There were 344 (88.9%) male and 43 (11.1%) females in Group A similarly, 164 (86.3%) male and 26 (13.7%). There were 128 (33.1%) diabetics, 184 (47.5%) hypertensive, 7 (1.8%) hyperlipidemia patients, 202 (52.2%) smokers and 141 (36.4%) patients with family history of premature coronary artery disease found in Group A, similarly, 65 (34.2%) diabetic, 88 (46.3%) hypertensive, 9 (4.7%) hyperlipidemia patients, 92 (48.4%) smokers and 75 (39.5%) patients with family history of premature coronary artery disease found in Group B. 1 (0.3%) in Group A and 1 (0.5%) in Group B use illicit drug in this study. In Group A 12 (3.1%) patients found with prior PCI, 0 (0%) with prior CABG, and 14 (3.6%) with prior MI, similarly in Group B 16 (8.4%) patients found with prior PCI, 1 (0.5%) with prior CABG and 7 (3.7%) with prior MI in this study.

Another study conducted by Hassan et. al, 2024[20] , 103 patients enrolled who had angiography performed, the predominant gender in the study was 73% male, with a mean age of 58 years. The most common risk factors were hypertension (33%), smoking (38%), and diabetes (39%). Of all the vessels, the Left Anterior Descending (LAD) was the most commonly obstructed (63%). Time delays from door-to-balloon were frequent, median door-to-balloon time was 169 minutes, frequently brought on by social problems and financial limitations. The majority (77.4%) of the patients had only percutaneous angiography (PCI), while 22.6% were recommended for bypass following PCI of the infarct-related artery (IRA). Complications in the delayed treatment group were the main cause of the death rate of 24.2%. [20]

The comparison of outcomes i.e., MI, cardiogenic shock, heart failure, CVA/Stroke, hemorrhagic, dissection, death, stent thrombosis, bleeding events within 72 hours, temponade, new requirement for dialysis, heamotoma, no flow reflow, perforation, and other vascular complications showed that there is no significant difference between both groups as p-values found insignificant i.e., 0.321, 0.350, 0.073, 0.537, 0.100, 0.483, 0.216, 0.321, 0.607, 1.00, 1.00, 0.668, 0.483, 1.00 and 0.483 respectively.

To pave the road for more efficient, patient-centered care by fostering a more thorough awareness of the complexities involved in the management of acute STEMI. The relevance of an early presentation was highlighted by the study's substantial negative association between presentation timing and D2B time ($r = -0.62$, p 0.001). Smaller myocardial infarct sizes and a decreased frequency of major adverse cardiac events (MACE) were seen in patients with D2B times under 90 minutes. Age and gender differences were seen in this connection, according to subgroup analysis. They concluded

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that timely patient presentation is crucial in achieving shorter D2B times, leading to improved clinical outcomes in primary PCI for STEMI. These findings underscore the need for public awareness campaigns and streamlined hospital protocols to optimize STEMI management.[21]

The relevance of an early presentation was highlighted by the study conducted by Kodeboina et. al,[22], the found negative association between presentation timing and D2B time (r = -0.62, *p* 0.001). Smaller myocardial infarct sizes and a decreased frequency of major adverse cardiac events (MACE) were seen in patients with D2B times under 90 minutes. Age and gender differences were seen in this connection, according to subgroup analysis.

In addition, studies have repeatedly found a link between longer door-to-balloon times and higher death rates. For example, in one study, in a continuous, nonlinear fashion, longer door-to-balloon times were associated with higher one-year mortality (30 minutes: 10.9%, 60 minutes: 13.6%, 90 minutes: 16.5%, 120 minutes: 19.5%, 150 minutes: 22.5%, 180 minutes: 25.3%, 210 minutes: 27.3%) [23] The start of treatment is further delayed by the general lack of knowledge about MI symptoms, their significance, and the necessity of obtaining prompt medical help. In one study carried on Mogadishu 53.35% of participants lacked sufficient knowledge about myocardial infarction. [24]

For time-sensitive situations like STEMI, educational programs are very important for making people more aware of and knowledgeable about how important it is to get medical help right away. A lack of knowledge about STEMI reduces the urgency to get help and be seen, which stresses the importance of educational programs to deal with these issues. [25]

Furthermore, another huge issue is the lack of funds. Patients and health providers both face the challenge of financial difficulties. As the equipment for a PCI procedure are scarce and expensive, health providers find themselves in a difficult situation. For instance, a study pointed out that people in Sub-Saharan Africa do not have easy access to expensive treatments like PCI devices. This means that people in this area have trouble getting advanced and expensive treatments for coronary artery disease. [26]

Conclusion

Treatment for acute myocardial infarction requires a door-to-balloon time, which presents special difficulties for the poor. While there has been a notable improvement in door-to-balloon timeframes for patients receiving primary percutaneous coronary intervention (PCI) for ST-segment elevation myocardial infarction, the rate of in-hospital mortality has remained essentially the same. These statistics indicate that further measures are required to decrease the number of deaths that occur within the hospital among this specific group of individuals.

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